Cottage Grove Landfill
Chicago, IL

Draft Risk Assessment
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I. Purpose:

This memorandum presents preliminary findings regarding potential human health risk at the Cottage Grove Landfill site (the landfill) and is based upon the Expanded Site Inspection Report, Cottage Grove Landfill, Chicago, Illinois, December 29, 1994. The purpose of this memorandum is to identify any human health risks at the site through the identification of contaminants of human health concern as well as exposure pathways. In addition, this assessment will identify any data gaps and the resulting assumptions required to assess risk.

II. Background:

The Cottage Grove Landfill site contains an inactive landfill that covers approximately 14 acres on an 18 acre property in Chicago, Illinois. The landfill is located directly west of the Land and Lakes #2 Landfill. Within four miles of the Cottage Grove Landfill, land use is a combination of recreational, industrial, and residential. The Cottage Grove Landfill has no engineered liner or leachate collection system.

The Cottage Grove Landfill operated from 1976 to 1982. In 1976, the present owner began landfilling activities onsite, accepting municipal, industrial, and commercial solid waste (i.e., household and demolition waste). The site was cited by IEPA for accepting hazardous waste, for which the facility was not permitted.

According to IEPA and USEPA files, inadequate capping of the landfill after closure caused slope erosion and leachate production. IEPA and FIT contractor documentation indicates that the facility has had observed leachate releases. Sampling performed in 1982 found elevated levels of contaminants in groundwater and on-site leachate ponds.

III. Data Gaps

The soil data reported in the ESI represent samples taken between 4 and 12 inches under ground. These soils would not normally be accessible and therefore cannot be considered as contributing to a complete exposure pathway. The ESI states the landfill has been capped and it is assumed that sampling was directed at obtaining contaminated soils which are located under the cap. This risk assessment uses data from the most contaminated sampling point SS06 and assumes that it is representative of a surficial soil sample. If the landfill is capped and the contaminated soils are inaccessible, then this risk assessment would greatly overestimate risk from exposure to contaminated soils.

It is likely that people consume fish caught in the Little Calumet River. Fish ingestion has been known to drive human health risk along rivers and it is possible that fish consumption could be a risk driver on this site. This assessment does not consider fish contamination data and therefore is not complete for this exposure pathway.

IV. Exposure Pathways:

In order to evaluate potential human health risk(s) that could be occurring at the site, various exposure pathways were considered. This assessment considers contamination data for soil, water and sediment. The chemicals of concern (COC) were identified by scanning the level of contamination by various compounds in the soil, water and sediment to determine whether contamination by any of the compounds was high enough to suggest possible human health risk. Heavy metals were found in the soil on the site and the COC's for human health risk in the soil were found to be beryllium and manganese. There were no COC's in the sediments or surface water. It is assumed that no one is drinking the groundwater and therefore that this is an incomplete exposure pathway.

A residence is located on the site. The residential exposure scenario generally involves maximal exposure to a given site. Any level of exposure which is less than that estimated as a residential exposure would result in less risk. Assessment of exposure using these parameters was determined to be conservative and protective for human health. In addition, to be protective, the risk analysis was performed using the highest level of contamination reported for a given chemical in a given medium. This assessment should therefore reflect the maximal risk under the defined exposure parameters. Thus, exposure to sites where the level of contamination is lower than that seen at these "hot spots," would yield a lower risk.

Exposure to contaminated soil can occur via incidental ingestion and dermal absorption. In order to be protective, dermal absorption was considered to be a risk despite the fact that, in general, metals do not absorb well through the skin.

An average residence at the site is assumed to be 30 years. In the case of the incidental ingestion exposure pathway, 5 of the 30 years are characterized by a child's exposure parameters. It is necessary to specifically assess incidental ingestion by a toddler due to the high incidence of soil/dust ingestion at this age. For dermal exposure, all 30 years are characterized by conservative adult parameters. These protective parameters were used to encompass a child's behavior pattern as well.

Another possible exposure pathway for dirt is dust inhalation. This pathway is not considered in the current assessment primarily due to vegetation in the area and the unlikelihood that this area will be heavily trafficked. If, for some reason, dust becomes an issue at the site, it would be advaisable to assess this pathway.

Data

The 1994 ESI included samples taken onsite which were located in close proximity to an onsite residence. The sample labeled SS06 was described as being "in the front yard of an onsite residence, about 35 feet from the home's front door. This sample contained the most hits for contaminants as well as some of the heaviest hits. Since this sample was so heavily contaminated and it was in close proximity to a residence, it was assumed to be representative of the worst case exposure on site. The use of this is maximum concentration gives an uper-bound estimate of the risk from the Cottage Grove Landfill.

Table 1

Media	Contaminant	Maximum Concentration (ppm)
Soil	Manganese	1,070
Soil	Beryllium	0.69

Dermal Exposure Equation-Soil

Equation for estimating exposure intake to contaminants due to dermal contact with chemicals (USEPA Risk Assessment Guidance for Superfund, 1989).

$$\text{Exposure} = \frac{CS \times SA \times AF \times ABS \times EF \times ED \times CF}{BW \times AT}$$

where:

CS	concentration in soil
SA	surface area
AF	soil to skin adherence factor
ABS	absorption
EF	exposure frequency
ED	exposure duration
BW	body weight
AT	averaging time

Table 2

Variable	Units	Value Used	Comment
CS	mg/kg	see Table 1	Data is taken from 1994 ESI
SA	cm^2	3,120 (soil)	arms and hands (adult) standard default exposure factors (RAGS Supplemental Guidance, March 1991)
AF	mg/cm^2	1	USEPA Risk Assessment Guidance for Superfund (1989)
ABS	none (fraction)	0.001	study assumption
EF	event/year	250	study assumption
ED	years	30	study assumption
CF	none	.000001	
BW	kg	70	(Exposure Factors Handbook, 1989, EPA/600/8-89/043)
AT	days	10,950 (noncancer) 25,550 (cancer)	(30 x 365) (70 x 365)

Ingestion Exposure Equation

Equation for estimating exposure intake to contaminants due to incidental ingestion of chemicals (USEPA RAGS, 1989).

$$\text{Exposure} = \frac{CS \times IR \times CF \times FI \times EF \times ED}{BW \times AT}$$

where:

CS	concentration in soil or groundwater
IR	ingestion rate
CF	conversion factor
FI	fraction ingested
EF	exposure frequency
ED	exposure duration
BW	body weight
AT	averaging time

Table 3

Variable	Units	Value Used	Comment
CS	mg/kg	see Table 1	Data is taken from 1994 ESI
IR	mg/day	200 (child) 100 (adult)	standard default exposure factors (RAGS Supplemental Guidance, March 1991)
CF	none	0.000001	
FI	none	1	study assumption
EF	days/year	250	study assumption
ED	years	soil 5 (child) 25 (adult)	standard default exposure factors (RAGS Supplemental Guidance, March 1991)
BW	kg	15 (child) 70 (adult)	standard default (RAGS Suppl. Guidance, March 1991)
AT	day	1,825 (child-noncancer) 9,125 (adult-noncancer) 25550 (cancer)	(5 x 365) (25 x 365) (30 x 365)

V. Toxicity

The COC consist of two heavy metals: manganese and beryllium. Toxicity information is taken from IRIS (7/96). Manganese is believed to not pose a risk for cancer, although it can cause noncarcinogenic health effects. Beryllium is believed to be carcinogenic as well as contribute to health effects are than cancer.

Carcinogens are chemicals which cause or induce cancer. Carcinogenic effects are assumed to demonstrate a nonthreshold response mechanism. This hypothesized mechanism for carcinogenesis is referred to as nonthreshold because it assumes that there is no level of exposure to such a chemical that does not pose finite probability, however small, of generating a carcinogenic response. The dose response relationship for cacinogens is expressed as a carcinogenic potency factor or slope factor that converts estimated intakes directly to incremental lifetime risk. Slope factors are expressed in units of the inverse of milligrams of chemical per kilogram of body weight per day.

Chemicals causing noncarcinogenic efects (i.e., systemic toxins) are assumed to exhibit a level of exposure above zero that can be tolerated by an organism without causing an observed health efect. It is believed that organisms have adaptive mechanisms that must be overcome before a toxic endpoint (effect) is manifested. Noncarcinogenic health effects include a variety of toxic effects on body systems ranging from renal toxicity (toxicity to the kidney) to central nervous system disorders. The toxicity value describing the dose-response relationship for noncarcinogenic effects is the RfD. U.S. EPA defines RfD as follows:
"In general, the RfD is an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily chemical exposure by the human population (including sensitive subpopulations) that is likely to be without appreciable risk of deleterious effects during a lifetime. The RfD is generally expressed in units of milligrams per kilogram of body weight per day (mg/kg-day)."
The noncarcinogenic risks presented in this memorandum will be presented as hazard indices with any number over one posing a human health risk.

Beryllium is classified as a probable human carcinogen and has a cancer slope factor of 4.3 kg-day/mg. Beryllium has been shown to induce lung cancer via inhalation in rats and monkeys and to induce osteosarcomas in rabbits via intravenous or intramdullary injection. Human epidemiology studies are considered to be inadequate.

Beryllium has a reference dose (RfD) of 0.003 mg/kg-day for dietary exposure. The RfD is based on no adverse effects and there is a low level of confidence in the value. Data on the teratogenicity or reproductive effects of beryllium are limited.

Manganese is a ubiquitous element that is essential for normal physiologic functioning in all animal species. Manganese has an RfD of 0.14 mg/kg-day for dietary exposure. The RfD is based upon central nervous system effects and is made with a medium level of confidence.

		Conc Soil (mg/kg)	Ingestion Rate (mg/day)	Conversion Factor (kg/mg)
	manganese	1070	200	0.000001
	beryllium	0.69	200	0.000001
	manganese	1070	100	0.000001
	beryllium	0.69	100	0.000001
		Conc Soil (mg/kg)	Surface Area (cm2)	Conversion Factor (kg/mg)
	manganese	1070	3,120	0.000001
	beryllium	0.69	3,120	0.000001

	Fraction Ingested	Exposure Frequency (days/year)	Exposure Duration (years)
	1	250	5
	1	250	5
	1	250	25
	1	250	25
Adherance Factor (mg/cm2)	Absorption	Exposure Frequency (days/year)	Exposure Duration (years)
1	0.001	250	30
1	0.001	250	30

Body Weight (kg)	AT (cancer)	AT-noncancer (days)		Soil	Cancer Intake (mg/kg-day)
15	25550	1825		manganese	0.000697978
15	25550	1825		beryllium	4.50098E-07
70	25550	9125		manganese	0.000373917
70	25550	9125		beryllium	2.41124E-07
Body Weight (kg)	AT-cancer (days)	AT-noncancer (days)		Soil	Cancer Intake (mg/kg-day)
70	25550	10950		manganese	1.39994E-05
70	25550	10950		beryllium	9.02768E-09

Cancer Slope (kg-day/mg)	Cancer Risk		Soil	NC Intake (mg/kg-day)	RfD (mg/kg-day)	NC Risk
NA	#VALUE!		manganese	0.009771689	0.14	0.069798
4.3	1.9354E-06		beryllium	6.30137E-06	0.005	0.00126
NA	#VALUE!		manganese	0.001046967	0.14	0.007478
4.3	1.0368E-06		beryllium	6.75147E-07	0.005	0.000135
Sum risk =	**2.9723E-06**				**Sum Haz =**	**0.078671**
Cancer Slope (kg-day/mg)	Cancer Risk		Soil	NC intake (mg/kg-day)	RfD (mg/kg-day)	NC Risk
NA	#VALUE!		manganese	3.26654E-05	0.14	0.000233
4.3	3.8819E-08		beryllium	2.10646E-08	0.005	4.21E-06
Sum risk =	**3.8819E-08**				**Sum Haz =**	**0.000238**
Sum all risk =	**3.0111E-06**				**Sum all Haz =**	**0.078909**